
Introduction to Printed Circuit Board Design and Fabrication

Course No. 472

FOR WHOM INTENDED This course is intended for personnel involved in designing, testing and manufacturing printed circuit boards. Degreed engineers whose primary training is not in this field will benefit, as will technicians, quality assurance inspectors and manufacturing engineers. Course 472 will also benefit managers and supervisors in charge of these functions.

BRIEF DESCRIPTION OF COURSE The course follows a step-by-step approach to the development and manufacturing cycle of a printed circuit board. After an overview of standards and existing technology, the course discusses the various engineering functions involved in PCB design and manufacturing. Specific issues are addressed in the areas of manufacturing and assembly, before moving on to PCB testing and quality assurance. The course addresses the potential pollution and safety impacts of PCB manufacturing, as well as applicable standards.

DIPLOMA PROGRAMS This course is a recommended elective for TTI's [Electronic Design Specialist \(EDS\)](#) diploma program, and may be used as an elective for any other [TTi specialist diploma program](#).

RELATED COURSES TTI is developing a complete PCB design curriculum, including Courses 473, on mechanical, structural and thermal considerations and layout, 474 on electrical considerations and layout, 475 on manufacturing, 476 on assembly and testing including quality assurance, and 477 on production including QA and screening.

PREREQUISITES Students should have completed TTI's Course 104-3, "[Electronics for Non-Electronic Engineers](#)" or the equivalent. This course is aimed toward individuals actively involved in related technical fields. An understanding of basic electrical theory is required.

TEXT Each student will receive 180 days access to the on-line electronic course workbook. Renewals and printed textbooks are available for an additional fee.

COURSE HOURS, CERTIFICATE AND CEUS On-site courses can vary from 14–35 hours over 2–5 days as requested by our clients. Upon successful course completion, each participant receives a certificate of completion and one Continuing Education Unit (CEU) for every ten class hours.

Course Outline

Introduction: General References & Standards • Technical Organizations
The Printed Circuit Board (PCB)

Definition and Evolution of the Printed Circuit Board (PCB)
Purposes of a PCB • Examples • Applications • Market Drivers
Typical Development Flow for a PCB • PCB Problems and Root Causes

Basic Electronic Components: Resistors, Capacitors, Inductors, Diodes, Transistors, Relays, Connectors

Integrated Circuits/ Printed Circuit Board Characteristics

Packaging Technology • PCB Types and Characteristics
Single Sided • Double-sided • Multi-layer PCB • Flexible and Rigid-flex

PCB Materials: Fillers, resins, laminates, base material characteristics, dielectric, conductors

Design & Environmental Requirements

Functional/Performance, Thermal, Vibration, Shock, EMI/EMC

Electrical Engineering

Analog and digital signals, Signal integrity, EMC, Grounding concepts, Current carrying capacity, CAD, Schematics, Layout rules of thumb

Mechanical Engineering: Panels, Standard board sizes, Packaging, CAD

Thermal Design: Heat transfer basics, Convection, Conduction, PCB

Thermal Design Features, Thermal modeling, Cycling and Fatigue

Math Models for Calculating Thermal Fatigue Stress, Examples

Reducing Thermal Cycling Fatigue Stress

Electrical Component Vibration Fatigue:

Structural Design and Analyses • Vibration Models

Combined Thermal and Structural Fatigue

Contamination Control/Environmental Control

Contamination Control • Conformal Coatings • Polluting Agents

Safety Controls • Pollution Controls • Recycling • Standards

Manufacturing

PCB Manufacturing Information

PCB Layout and Artwork • Fabrication

Machining Operations: Blanking, Cutting, Punching, Drilling

Laminating Techniques • Plating, Etching, Surface Finishing

Conformal Coatings • Inspection and Checkout

Specifications and Standards

Assembly

PCB Assembly Drawing Examples • Component considerations

Component mounting and support • Mechanical Devices

Soldering Technology: Hand and Mass Soldering, Dip, Wave, Reflow

Cleaning • Parts Staking • Conformal Coating removal

Repair and Rework • Safety Considerations • ESD protection

Specifications and Standards

Testing

Common PCB Production Faults • Bare Board Testing

Electrical Performance Testing • Assembled PCB Testing

Quality Assurance

Introduction • Quality Assurance in Design

FMEA – Failure Mode and Effects Analysis • Software Tools

Quality Assurance in Manufacturing and in Assembly

Specifications and Standards

Final Review • Certificates for Successful Completion



**Technology
Training, Inc.**

(a tti group company)

Toll-free telephone: 866-884-4338 (866-TTi-4edu)

International: 805-845-5050

E-mail: Training@ttiedu.com

www.ttiedu.com